

General

Title

Optimizing patient exposure to ionizing radiation: percentage of total CT studies performed for all patients, regardless of age, that are reported to a radiation dose index registry and that include at a minimum selected data elements.

Source(s)

American Board of Medical Specialties (ABMS), American Medical Association-convened Physician Consortium for Performance Improvement® (PCPI®), American College of Radiology (ACR). Optimizing patient exposure to ionizing radiation performance measurement set. Reston (VA): American College of Radiology; 2016 Jan. 51 p. [53 references]

Measure Domain

Primary Measure Domain

Clinical Quality Measures: Structure

Secondary Measure Domain

Clinical Quality Measure: Process

Brief Abstract

Description

This measure is used to assess the percentage of total computed tomography (CT) studies performed for all patients, regardless of age, that are reported to a radiation dose index registry and that include at a minimum selected data elements.

Rationale

Clinical registries have become an important tool in efforts to improve quality of care. Registries provide a structured mechanism to monitor clinical practice patterns, evaluate healthcare effectiveness and safety, and evaluate patient outcomes (Gliklich & Dreyer, 2007; Engelberg Center for Health Care Reform at Brookings Institution, 2010; Bufalino et al., 2011). Clinical registries like the ADHERE, Get with the Guidelines and the Advanced Cardiovascular Imaging Consortium registries, have been associated with

performance improvement by registry participants (Engelberg Center for Health Care Reform at Brookings Institution, 2010; Fonarow et al., 2005; LaBresh et al., 2004; Raff et al., 2009).

Establishing diagnostic reference levels is vital to helping clinicians determine optimal radiation dosage to produce acceptable image quality. A data registry such as the American College of Radiology (ACR) Dose Index Registry (DIR) allows facilities to compare their computed tomography (CT) dose indices to regional and national values enabling imaging providers and the imaging community to measure the effectiveness of dose lowering efforts over time.

Reference levels are based on actual patient doses for specific procedures measured at a number of representative clinical facilities. The levels are set at approximately the 75th percentile of these measured data, meaning that the procedures are performed at most institutions with doses at or below the reference level. Consequently, reference levels are suggested action levels at which a facility should review its methods and determine if acceptable image quality can be achieved at lower doses (ACR, 2008).

A prospective, controlled, nonrandomized study using a cardiac computed tomography angiography registry found that consistent application of dose-reduction techniques was associated with a reduction in estimated radiation doses without impairment of image quality (Raff et al., 2009).

During the follow-up period, patients' estimated median radiation dose was reduced by 53% and effective dose from 21 mSv to 10 mSv as compared with the control period (Raff et al., 2009).

The following clinical recommendation statements are quoted verbatim from the referenced clinical guidelines:

The goal in medical imaging is to obtain image quality consistent with the medical imaging task. Diagnostic reference levels are used to manage the radiation dose to the patient. The medical radiation exposure must be controlled, avoiding unnecessary radiation that does not contribute to the clinical objective of the procedure. By the same token, a dose significantly lower than the reference level may also be cause for concern, since it may indicate that adequate image quality is not being achieved. The specific purpose of the reference level is to provide a benchmark for comparison, not to define a maximum or minimum exposure limit (ACR, 2008).

For CT, the diagnostic reference levels are based on the volume CT dose index (CTDIvol) (ACR, 2008).

Evidence for Rationale

American Board of Medical Specialties (ABMS), American Medical Association-convened Physician Consortium for Performance Improvement® (PCPI®), American College of Radiology (ACR). Optimizing patient exposure to ionizing radiation performance measurement set. Reston (VA): American College of Radiology; 2016 Jan. 51 p. [53 references]

American College of Radiology (ACR). ACR practice guideline for diagnostic reference levels in medical x-ray imaging. Reston (VA): American College of Radiology (ACR); 2008.

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Raff GL, Chinnaiyan KM, Share DA, Goraya TY, Kazerooni EA, Moscucci M, Gentry RE, Abidov A, Advanced Cardiovascular Imaging Consortium Co-Investigators. Radiation dose from cardiac computed tomography before and after implementation of radiation dose-reduction techniques. JAMA. 2009 Jun 10;301(22):2340-8. [PubMed](#)

Primary Health Components

Ionizing radiation; computed tomography (CT); radiation dose index registry

Denominator Description

All computed tomography (CT) studies performed for all patients, regardless of age

Numerator Description

Computed tomography (CT) studies performed that are reported to a radiation dose index registry AND that include at a minimum all of the following data elements:

- Manufacturer
- Study description
- Manufacturer's model name
- Patient's weight
- Patient's size
- Patient's sex
- Patient's age
- Exposure time
- X-ray tube current
- Kilovoltage (kV)
- Mean volume computed tomography dose index (CTDIvol)
- Dose-length product (DLP)

See the related "Numerator Inclusions/Exclusions" field.

Evidence Supporting the Measure

Type of Evidence Supporting the Criterion of Quality for the Measure

A clinical practice guideline or other peer-reviewed synthesis of the clinical research evidence

A formal consensus procedure, involving experts in relevant clinical, methodological, public health and

One or more research studies published in a National Library of Medicine (NLM) indexed, peer-reviewed journal

Additional Information Supporting Need for the Measure

Importance of Topic

The use of medical imaging has resulted in revolutionary advances in the practice of medicine. The increased sophistication and clinical efficacy of imaging have resulted in its considerable growth. Consequently, the evolution of imaging has resulted in a significant increase in the population's cumulative exposure to ionizing radiation and a potential increase in adverse effects including cancer (Amis, Butler, & American College of Radiology [ACR], 2010; Amis et al., 2007). Although experts may not agree on the extent of the risks of cancer from medical imaging, there is uniform agreement that care should be taken to weigh the medical necessity of a given level of radiation exposure against the risks, and that steps should be taken to eliminate avoidable exposure to radiation (Amis et al., 2007; Center for Devices and Radiological Health [CDRH], 2010).

High Impact Topic Area

This topic was chosen for measure development because of the high costs associated with imaging studies and because these medical procedures are a significant source of radiation exposure. The following objective data support the degree of increase in the use of imaging studies and emphasize the importance in taking steps to help eliminate avoidable exposure.

Prevalence and Incidence

The average per capita exposure to ionizing radiation from imaging exams increased by about 600% from 1980 to 2006 in the United States (U.S.) (Mettler et al., 2009; National Council on Radiation Protection and Measurements [NCRP], 2009).

The largest contributor to this dramatic increase in population radiation exposure is computed tomography (CT). In 1980 fewer than 3 million CT scans were performed; in 2006, there were about 380 million radiologic procedures (including 67 million CT scans) and 18 million nuclear medicine procedures performed in the U.S. (Mettler et al., 2009).

The imaging study with the single highest radiation burden, accounting for 22% of cumulative effective dose, is myocardial perfusion imaging (Fazel et al., 2009).

In 2006, an estimated 19 million head, 10.6 million chest and 21.2 million abdominal and pelvic CT scans were performed accounting for 28%, 15.9%, and 31.7%, respectively, of the total number of CT scans in the U.S. (Mettler et al., 2009).

Currently, approximately 11% of CT examinations are performed on children, which could account for more than 7 million pediatric CT examinations per year in the U.S. (Mettler et al., 2000; Frush & Applegate, 2004; Linton, Mettler, & NCRP, 2003).

The prevalence of CT or magnetic resonance imaging (MRI) use during emergency department (ED) visits for injury-related conditions increased from 6% in 1998 to 15% in 2007 (Korley, Pham, & Kirsch, 2010).

While CT utilization has decreased steadily since 2003 in pediatric facilities across North America (Townsend et al., 2010) the use of CT in children who visit the ED increased from 0.33 to 1.65 from 1995 to 2008 and occurred primarily at non-pediatric focused facilities (Larson et al., 2011).

Costs

From 2000 through 2006, total Medicare expenditures for physician imaging services increased from \$6.7 billion to about \$14 billion, an increase of 13% per year on average (U.S. Government Accountability Office [GAO], 2008).

In 2005 imaging services represented an estimated 14% of 2005 spending included in the sustainable growth rate (SGR) calculation, but represented 27% of the total increase in such spending between 2004 and 2005. The majority of the growth occurred for advanced imaging (GAO,

2008).

In 2006, advanced imaging, including CT and MRI, accounted for 54% of total Medicare imaging expenditures, up from 43% in 2000. This translates to an increase in Medicare spending on advanced imaging from about \$3 billion in 2000 to about \$7.6 billion in 2006 (GAO, 2008).

Disparities

There is variation according to age, sex, and health care market in the proportion and mean dose of patients undergoing medical imaging procedures. One study concluded that the proportion of subjects undergoing at least one imaging procedure was higher in older patients, rising from 49.5% of those who were 18 to 34 years old to 85.9% of those who were 60 to 64 years old. The study also found that women underwent procedures significantly more often than men, with a total of 78.7% of women undergoing at least one procedure during the study period, as compared with 57.9% of men (Fazel et al., 2009).

Opportunity for Improvement

One retrospective cross-sectional study describing radiation dose associated with some of the most common types of diagnostic CT found variable radiation doses. The study found variability in the following exams: 1) routine chest exam without contrast, the CT effective doses ranged from 2 mSv to 24 mSv; 2) routine abdomen-pelvis, no contrast - CT effective dose ranged from 3 mSv to 43 mSv; 3) routine head exam - CT effective dose ranging from 0.3 mSv to 6 mSv (Smith-Bindman et al., 2009).

A central database established for collecting dose indices as a function of patient qualities (i.e., gender, age, size, etc.) and exam type (i.e., lateral lumbar spine, pelvis CT, etc.), would allow the relative range of radiation dose indices to be analyzed and compared against established benchmarks.

Evidence for Additional Information Supporting Need for the Measure

American Board of Medical Specialties (ABMS), American Medical Association-convened Physician Consortium for Performance Improvement® (PCPIA®), American College of Radiology (ACR). Optimizing patient exposure to ionizing radiation performance measurement set. Reston (VA): American College of Radiology; 2016 Jan. 51 p. [53 references]

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Korley FK, Pham JC, Kirsch TD. Use of advanced radiology during visits to US emergency departments for injury-related conditions, 1998-2007. JAMA. 2010 Oct 6;304(13):1465-71. [PubMed](#)

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Smith-Bindman R, Lipson J, Marcus R, Kim KP, Mahesh M, Gould R, Berrington de Gonzalez A, Miglioretti DL. Radiation dose associated with common computed tomography examinations and the associated lifetime attributable risk of cancer. *Arch Intern Med*. 2009 Dec 14;169(22):2078-86.

Townsend BA, Callahan MJ, Zurakowski D, Taylor GA. Has pediatric CT at children's hospitals reached its peak?. *AJR Am J Roentgenol*. 2010 May;194(5):1194-6. [PubMed](#)

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Extent of Measure Testing

The measures in this set are being made available without any prior formal testing. However, many of the measures in this set (Utilization of a Standardized Nomenclature for CT Imaging Description, Count of Potential High Dose Radiation Imaging Studies: Computed Tomography (CT) and Cardiac Nuclear Medicine Studies, CT Images Available for Patient Follow-Up and Comparison Purposes, Search for Prior CT Studies through a Secure, Authorized, Media-free, Shared Archive, Appropriateness: Follow-up CT Imaging for Incidentally Detected Pulmonary Nodules According to Recommended Guidelines and Reporting to a Radiation Dose Index Registry) have been in use in the Centers for Medicare and Medicaid Services (CMS) Physician Quality Reporting System program since 2013 indicating the feasibility of collecting the data elements required for measure calculation.

The American College of Radiology (ACR) recognizes the importance of thorough testing all of its measures and encourages ongoing robust testing of the Optimizing Patient Exposure to Ionizing Radiation measurement set for feasibility and reliability by organizations or individuals positioned to do so. The ACR will welcome the opportunity to promote such testing of these measures and to ensure that any results available from testing are used to refine the measures on an ongoing basis.

Evidence for Extent of Measure Testing

American Board of Medical Specialties (ABMS), American Medical Association-convened Physician Consortium for Performance Improvement® (PCPI®), American College of Radiology (ACR). Optimizing patient exposure to ionizing radiation performance measurement set. Reston (VA): American College of Radiology; 2016 Jan. 51 p. [53 references]

State of Use of the Measure

State of Use

Current routine use

Current Use

not defined yet

Application of the Measure in its Current Use

Measurement Setting

Ambulatory/Office-based Care

Ambulatory Procedure/Imaging Center

Emergency Department

Hospital Inpatient

Hospital Outpatient

Professionals Involved in Delivery of Health Services

not defined yet

Least Aggregated Level of Services Delivery Addressed

Individual Clinicians or Public Health Professionals

Statement of Acceptable Minimum Sample Size

Does not apply to this measure

Target Population Age

All ages

Target Population Gender

Either male or female

National Strategy for Quality Improvement in Health Care

National Quality Strategy Aim

Better Care

National Quality Strategy Priority

Institute of Medicine (IOM) National Health Care Quality Report Categories

IOM Care Need

Not within an IOM Care Need

IOM Domain

Not within an IOM Domain

Data Collection for the Measure

Case Finding Period

Unspecified

Denominator Sampling Frame

Patients associated with provider

Denominator (Index) Event or Characteristic

Diagnostic Evaluation

Denominator Time Window

not defined yet

Denominator Inclusions/Exclusions

Inclusions

All computed tomography (CT) studies performed for all patients, regardless of age

Exclusions

Unspecified

Exclusions/Exceptions

not defined yet

Numerator Inclusions/Exclusions

Inclusions

Computed tomography (CT) studies performed that are reported to a radiation dose index registry (DIR) AND that include at a minimum all of the following data elements:

- Manufacturer
- Study description
- Manufacturer's model name
- Patient's weight
- Patient's size
- Patient's sex
- Patient's age
- Exposure time
- X-ray tube current
- Kilovoltage (kV)
- Mean volume computed tomography dose index (CTDIvol)
- Dose-length product (DLP)

Note: Detailed information regarding the patient demographic and scanner data elements included in the Digital Imaging and Communication in Medicine (DICOM) header and CT irradiation event data elements included in the *DICOM Supplement 127: CT Radiation Dose Reporting (Dose Structured Report)* can be found in the Dose Index Registry Data Dictionary available on the [American College of Radiology \(ACR\) Web site](#) .

Exclusions

Unspecified

Numerator Search Strategy

Fixed time period or point in time

Data Source

Administrative clinical data

Documentation of organizational self-assessment

Registry data

Type of Health State

Does not apply to this measure

Instruments Used and/or Associated with the Measure

Unspecified

Computation of the Measure

Measure Specifies Disaggregation

Does not apply to this measure

Scoring

Rate/Proportion

Interpretation of Score

Desired value is a higher score

Allowance for Patient or Population Factors

not defined yet

Standard of Comparison

not defined yet

Identifying Information

Original Title

Measure #1: reporting to a radiation dose index registry.

Measure Collection Name

Optimizing Patient Exposure to Ionizing Radiation Performance Measurement Set

Submitter

American College of Radiology - Medical Specialty Society

Developer

American College of Radiology - Medical Specialty Society

Physician Consortium for Performance Improvement® - Clinical Specialty Collaboration

Funding Source(s)

Unspecified

Composition of the Group that Developed the Measure

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Financial Disclosures/Other Potential Conflicts of Interest

None of the members of the Patient Optimizing Patient Exposure to Ionizing Radiation Work Group had any disqualifying material interests under the Physician Consortium for Performance Improvement (PCPI) Conflict of Interest Policy.

Measure Initiative(s)

Physician Quality Reporting System

Adaptation

This measure was not adapted from another source.

Date of Most Current Version in NQMC

2016 Jan

Measure Maintenance

This measure set is reviewed and updated every 3 years

Date of Next Anticipated Revision

2017

Measure Status

This is the current release of the measure.

Measure Availability

Source available from the [American College of Radiology \(ACR\) Web site](#) .

For more information, contact ACR at 1891 Preston White Drive, Reston, VA 20191; Phone: 703-648-8900; E-mail: info@acr.org; Web site: www.acr.org .

NQMC Status

This NQMC summary was completed by ECRI Institute on November 4, 2015. The information was verified by the measure developer on December 29, 2015.

Copyright Statement

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Production

Source(s)

American Board of Medical Specialties (ABMS), American Medical Association-convened Physician Consortium for Performance Improvement® (PCPI®), American College of Radiology (ACR). Optimizing patient exposure to ionizing radiation performance measurement set. Reston (VA): American College of Radiology; 2016 Jan. 51 p. [53 references]

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